PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

PLANTERS' BULLETIN THIRTYSIX

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PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

Kuala Lumpur May 1958 Number 36

Editorial: Now is the Time

Producers of natural rubber are being constantly reminded of the outstanding advances made by the synthetic rubber industry to improve its production methods and the quality of its products. Intensive research and development stand behind these advances; so, everyone is agreed, research for natural rubber must be intensified and vigorously pursued with the clear objectives of reducing the cost of production and improving the quality of the product.

There are many rubber growers who think that the quality of the product is of lesser importance, and that the emphasis in research should be on improving efficiency in production. Let us, then, attempt to assess the industry's efforts to meet the challenge of synthetic rubber in this way. The best measure we have is yield per acre. To what extent has the rubber producing industry in Malaya used the results of research directed towards increasing yield?

A study of the data presented in the Malayan *Rubber Statistics Handbook* for 1956 reveals some interesting facts. First, we shall examine smallholders' production. Accurate estimates of the planted acreage of smallholdings are not available for reasons given in Appendix 2 of the Handbook. Since 1946, a figure of 1,500,000 acres has been taken. It is known that at least 150,000 acres have been replanted since then and, at a rough guess, another 100,000 acres can be allowed as being, for various reasons, not tapped during the year. We are left with an estimate of 1,250,000 acres as the area of smallholders' rubber in tapping. With production at 274,400 tons, the average yield works out to 492 lb per acre.

This estimate of smallholders' production is subject to two kinds of error, having opposite effects. On the one hand, the acreage of smallholders' rubber may have been overestimated, as is indicated by a re-examination of the records in a number of districts, reported in the Handbook, showing an overestimate of 130,000 acres out of a total of 800,000. On the other hand, because smallholders' production is taken as the difference between estates' recorded production and the total Malayan output, it may appear larger than it really is, for it is possible that rubber not produced on smallholdings contributes to this difference figure. If the area of smallholdings and their production have both been overestimated, the two sources of errors will tend to cancel out when production is calculated as yield per acre. We may therefore

take the figure of 492 lb per acre as a reasonably good estimate of the average smallholders' output.

We turn now to estates' production, for which the records are complete and a closer examination of their efficiency is possible. From 2,491 estates of 100 acres and over the average yield was 496 lb per acre – practically the same as the smallholders' output – a most striking result. Despite their advantages in the use of high-yielding planting material and improved methods, estates as a whole are contributing little more to the production of rubber per acre of land than the smallholders, whose methods are considered to be out-dated. The smallholder has held this position with what are regarded as obsolete, low yielding trees, and wasteful methods of tapping.

It is instructive to divide estates into two groups according to the proportion of their tapped area which is planted with improved high yielding trees. Those with less than half their acreage planted with improved material (numbering 1,853) harvested 394 lb per acre from 981,230 acres tapped. Those with more than half (638 in number) harvested 660 lb per acre from 606,791 acres tapped. We see that three quarters of the estates, owning 60% of the estate acreage, are producing nearly 100 lb per acre per year less than the average for smallholders. The levels of yield obtained with their improved material by the below-average and above-average estates were not very different – 757 and 789 lb per acre respectively. The greater productivity of the above-average estates is largely due to the greater extent to which they have been planted with high yielding material. It is in this way that the estate section of the industry as a whole has succeeded in reaching parity of production per acre with smallholders, mainly through the efforts of the more progressive owners of 40% of the estate acreage. Nearly half a million acres of high yielding rubber – buddings and clonal seedlings – gave an average of 781 lb per acre tapped, against 364 lb over more than a million acres of unselected seedlings.

The wide range of efficiency of estates may be strikingly illustrated by a few more figures, culled from the annual reports of three large companies, which we will label A, B and C.

	A	B	C
Total acreage planted	36,000	32,000	28,000
Acreage of unselected seedlings	9,000	16,000	22,000
Acreage of high-yielding material	19,000	11,000	2,000
Total acreage in bearing	28,000	27,000	24,000
Acreage of immature rubber — replantings and new plantings	8,000	5,000	4,000
Total crop for one year, in pounds of dry rubber	21,000,000	13,200,000	7,800,000
Yield per acre tapped, in pounds per acre	750	490	320

Group A produces one and a half times as much rubber per acre tapped as group B, and well over twice as much as group C. These production figures clearly illustrate the Mudie Mission's dictum 'replant or die'.

The urgent need is for the industry to use the improved material that research has made available over the past twentyfive years. We know some of the reasons why producers have been slow to plant it: the slump of the early thirties, rubber regulation schemes and restriction of new planting and replanting, war and rehabilitation. Now is the time to catch up.

Buddings and Clonal Seedlings

THE RELATIVE MERITS of buddings and seedlings form a perennial subject for discussion. Before we review the advantages and disadvantages of each type of material, it is of interest to record the extent to which they are being used on estates. The figures tabulated,* giving the total acreages planted on estates with each type of material in the two years for which records are available, show that both clones and clonal seedlings are extensively used but that the former are generally preferred.

Year	*1955*	*1956*
Budded clones	30,288	47,815
Clonal seedlings	26,803	38,122

We shall make our comparisons of the relative merits of buddings and seedlings under the headings: yield, vigour, virgin bark, renewed bark, planting density, tapping system, suitability of latex, susceptibility to disease, site, improvement; finally we give our general conclusions.

YIELD

A summary of yields obtained in variety trials conducted by the R.R.I. on cooperating estates is given in the accompanying table, where three 500 series clones are compared with three clonal seedling families over a period of ten years. The P.B.I.G.seedlings from the polyclonal gardens C, D and E of the Prang Besar Company, the Tjir 1 seedlings, and the R.R.I. Experiment Station field 18 mixed (polyclonal garden) seedlings, are typical of the best proven clonal seedling families currently available for large scale planting in Malaya.

The yields may be compared either as pounds per acre per year or as a percentage of the control clone, which was Pil B84 budded throughout. It will be noted that Pil B84 yielded less in the clonal seedling trials than in the clone trials, probably owing to its having been somewhat suppressed in the seedling trials, where it was budded in the field one year after the seedlings were planted. Because of this difference in

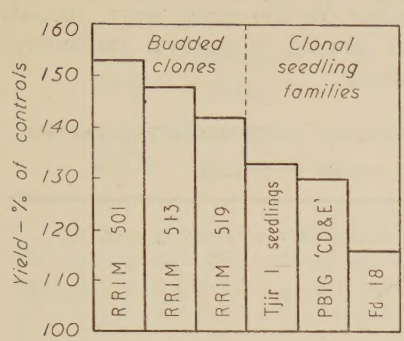
* We are indebted to the Registrar of Statistics for permission to publish these figures, extracted from the *Rubber Statistics Handbook, 1955 & 1956.* It should be noted that some clonal seedlings are budded the following year.

YIELDS OF THREE RRIM 500 SERIES CLONES AND THREE CLONAL SEEDLINGS FAMILIES

Mean yield per acre per annum in pounds

Budded clones and seedling families	*Years after budding clones or planting seedlings*									
	8	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*
RRIM 501	1137	1245	1361	1514	1600	1685	1650	1349	1366	1501
Control Pil B84	747	737	849	985	1069	1113	1087	966	918	949
Number of records	*6*	*10*	*10*	*10*	*10*	*10*	*10*	*9*	*8*	*6*
RRIM 513	1115	1190	1515	1397	1463	1615	1678	1550	1434	1614
Control Pil B84	783	702	803	934	1080	1211	1205	1110	1006	1024
Number of records	*2*	*5*	*5*	*5*	*5*	*5*	*5*	*4*	*4*	*2*
RRIM 519	1004	1152	1163	1176	1288	1623	1697	1401	1429	1469
Control Pil B84	602	707	825	896	1009	1205	1225	1065	966	920
Number of records	*2*	*5*	*5*	*5*	*5*	*5*	*5*	*4*	*4*	*3*
PBIG 'CD & E'	823	1131	1161	1195	1157	1113	1138	1117	1178	1040
Control Pil B84*	419	712	797	780	918	913	1068	1016	957	896
Number of records	*2*	*5*	*7*	*7*	*7*	*7*	*7*	*6*	*6*	*5*
Tjir 1 seedlings	755	1140	1107	1141	1141	1160	1128	1061	1109	1075
Control Pil B84*	419	694	759	784	833	919	1021	969	892	843
Number of records	*2*	*4*	*6*	*6*	*6*	*6*	*6*	*5*	*5*	*4*
RRIES Field 18	664	1012	1100	1121	1193	955	1070	1071	1155	1128
Control Pil B84*	387	716	911	843	1037	961	1085	1084	1097	909
Number of records	*1*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*3*	*1*

* budded one year after planting clonal seed

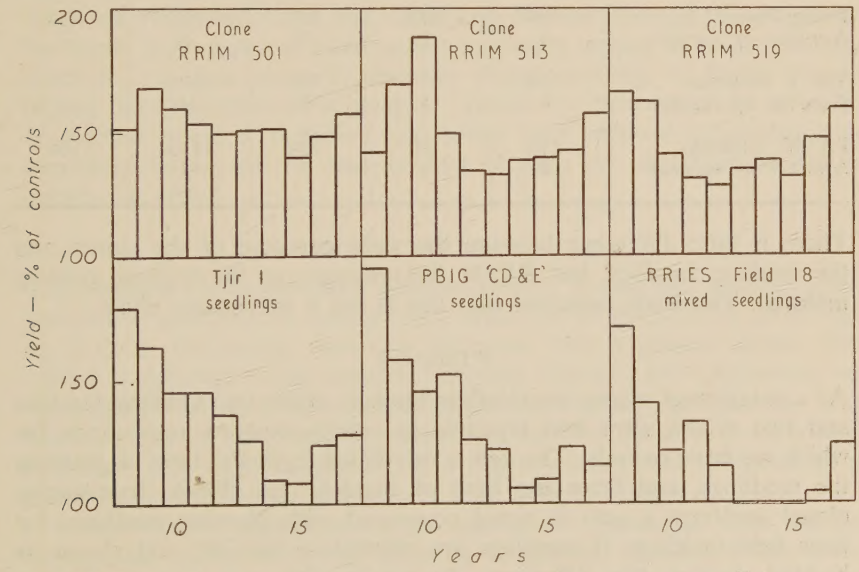


Yield of clones and clonal seedlings over ten years.

level of yield of the control clone, it is probably fair to compare the buddings and seedlings on the basis of yield per acre. The clones emerge as considerably higher yielding than the seedlings. Even if the yield is expressed as a percentage of the controls, to obviate differences between the various trials, it is seen from the diagrams that the clones yielded substantially more than the clonal seedling families over the whole ten year period.

It will be noted that the number of test sites was not the same throughout, and that tapping commenced later than is normal in commercial practice today. Both result from the outbreak of war and the later emergency. Certain trials were lost. In the ones that survived tapping was delayed while conditions remained unsettled.

It is known that severe selection of the clonal seedlings was practiced in the nursery, and selective thinning programmes were followed after the war, in both series of trials. Therefore, although there were inevitable departures from current practice, the general comparison is reasonably fair and, over the ten years reviewed, the clones yielded 3,000 pounds per acre more than the clonal seedling families.



Yield of clones and clonal seedlings year by year expressed as percentage of controls.

In order to fill the gap in information for the early years, records have been compiled from commercial tapping of postwar replantings on estates over a wide range of conditions.

YIELDS OF BUDDINGS AND CLONAL SEEDLINGS IN COMMERCIAL TAPPING

Mean yield per acre per annum in pounds

Budded clones and seedling families	*Years after budding clones or planting seedlings*				
	5—6	*6—7*	*7—8*	*8—9*	*9—10*
Glen 1	477	680	795	866	955
Number of records	*8*	*14*	*10*	*4*	*1*
Tjir 1	323	451	529	897	
Number of records	*3*	*12*	*9*	*2*	
RRIM 501	513	743	1123	1342	1830
Number of records	*22*	*19*	*16*	*3*	*1*
Prang Besar 86	477	573	613	683	
Number of records	*7*	*10*	*5*	*2*	
PR 107	291	540	730	770	
Number of records	*5*	*5*	*1*	*1*	
Chemara E garden	549	690	812	757	917
Number of records	*8*	*12*	*11*	*8*	*2*
Prang Besar I.G.	394	532	739	593	934
Number of records	*6*	*8*	*5*	*2*	*1*
Tjir 1 seedlings	534	673	705	699	
Number of records	*4*	*5*	*2*	*1*	
PB 86 seedlings	210	390	704	1110	1106
Number of records	*2*	*3*	*2*	*1*	*1*

There is little difference between the yield per acre of the clones and the seedling families, but RRIM 501 emerges as the highest yielding material. The trials indicated that this is not a precocious effect.

VIGOUR

As a measure of vigour we tabulate the ages when two seedling families and two clones were first tappable in estates postwar replantings for which we have records. The age is calculated from the time of planting the seedlings, and from the time of budding the clones. In planting clonal seedlings a year is saved compared with planting seedlings for later field budding. If seedlings are planted as stumps, and clones as budded stumps, this difference disappears. Otherwise, as the figures show, there is little to choose between the two categories.

Years	$5-5\frac{1}{2}$	$5\frac{1}{2}-6$	$6-6\frac{1}{2}$	$6\frac{1}{2}-7$
Tjir 1 seedlings	3	2	1	–
PBIG seedlings	4	4	1	1
PB 86 buddings	2	7	2	1
RRIM 501 buddings	15	7	2	1

VIRGIN BARK

No variety has been found to have an inadequate thickness of virgin bark when the girth is adequate for opening. An apparent advantage of clonal seedlings in this respect is due to a greater amount of corky tissue, which has some value in supporting the knife – making it easier to tap – but which does not affect the amount of latex-bearing inner bark.

RENEWED BARK

In general, provided that the stand of trees per acre is the same, the thickness of renewed bark bears an inverse relationship to the yield from virgin bark. Thus, clones or clonal seedlings of similar yield produce renewed bark of about the same thickness. The highest yielding clones, however, do have somewhat thinner renewed bark; but, at the densities recommended for planting, it has been found adequate for tapping after seven years.

Considering the average figures for all the clones and all the seedling families in the trials which we have been discussing, the clonal seedlings had better bark renewal than the clones during the first four years. After six years the clones had caught up and the average thickness was the same. Both types of planting material were tapped at similar stands, whereas it is now usual to maintain clonal seedlings at higher stands during the early years of tapping to provide for later selection on yield. In normal practice, therefore, the better bark renewal of seedlings in the early stages will be less marked because the closer stand has a depressing effect.

PLANTING DENSITY

The problem of the optimum planting density is one that requires comprehensive experiments lasting many years for its elucidation, involving, as it does, fluctuating economic elements. For a general review the reader is referred to the articles 'Planting Density' and 'Achieving an Optimum Stand' in *Planters' Bulletin 22* and *Planters' Bulletin 34*. It is relevant here to note that, to obtain the best performance from clonal seedlings, they must be planted at a higher density and subjected to a more stringent thinning programme than with buddings.

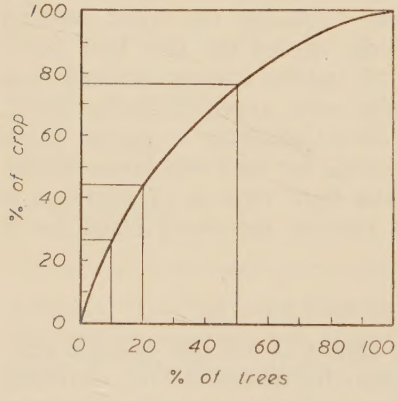
If budwood is multiplied on the estate, 180 plants per acre can be budded for up to $23. The figure is, of course, doubled if two trees per point are budded to provide a surplus for supplying. Germinated clonal seeds cost from seven to twentyfive cents each. Allowing for the

elimination of runts, but ignoring transport charges, the cost of 240 clonal seedlings per acre will range from $20 to over $60. There is a temptation to cut down the amount of more expensive material. This should be resisted, as it results in inadequate selective thinning.

As compared with planting clonal seedlings, field budding entails the cost of weeding during an extra year. Against this, the cost of fertiliser expended on plants which will later be eliminated is a greater loss with seedlings than with buddings. Apart from the budding operation, the two types of plant require equal care in planting and pruning, but clonal seedlings need closer supervision in the practice of a selective thinning programme, which is necessary to realise their best potentialities. When all factors are taken into account, clonal seedlings no longer appear to be the cheap material to raise that they are often claimed to be.

TAPPING SYSTEM

Experiments on high yielding material have shown that alternate daily tapping of clonal seedlings on a half spiral cut (S/2.d/2.100%) results in a high incidence of brown bast, to which the high yielding trees are more prone than the low yielders. The yield capacity of individual trees in a stand of seedlings varies greatly. Though the level of yield is very different between selected and unselected seedlings, the form of the distribution of yield is much the same and is illustrated in the graph, showing that 50% of the trees give 77% of the crop; 20% give 44%, while the best 10% give 27% of the crop. Because brown bast cases occur mainly among the highest yielding trees, the loss of crop from affected trees is higher than the proportion of trees rested for this cause. A brown bast incidence of 15 to 20% has been found in several of our clonal seedling trials tapped S/2.d/2.100%. This could mean a 40% loss in crop. When seedlings are tapped third-daily, however, the brown bast incidence rarely rises above 5%. Compared with S/2.d/2.100%, tapping S/2.d/3.67% results in an immediate drop in yield of 20 to 25%, but this differential is reduced over the years by the lower brown bast incidence and better girth increment on the 67% system. Our recommendations are that seedling trees should be tapped S/2.d/3.67% from first opening; after four years S/2.d/2.100% tapping can be attempted but the areas should revert as soon as the brown bast incidence reaches 10%.



Distribution of yield in a seedling population.

There are certain clones sensitive to brown bast, such as Glen 1, but the majority have been selected for their freedom from it. Thus, when the price of rubber is suitable, most buddings can be continuously exploited on S/2.d/2.100%.

When considering the relative merits of clones and clonal seedlings a further matter to be borne in mind is the shape of the tree. The trunk of a seedling tree tapers more than that of a budding and thus has a relatively greater girth low down on the tree than has a clone of the same age. As the cut gets lower on a seedling its length increases, and with it the yield. Considering that the height of opening is normally 20 inches from the ground for seedlings, but not less than twice this height for buddings, it is not surprising that clonal seedlings often yield as much as clones in the early years of tapping, though their later performance is inferior. The shape of a budded tree makes it possible to open it as high as the tapper can conveniently reach. In later life, high panels of similar dimensions are available for ladder tapping. Whereas ladder tapping of clonal seedlings in virgin bark usually gives a lower yield than from the renewed bark of the original panels, the reverse is true in most instances of high tapping on clones.

It is well known that tapping towards the junction of bark of different ages gives a severe drop in yield. To obtain early yields, clonal seedlings must of necessity be opened low down in the stem; bark islands are therefore difficult to avoid. With clones opened at 60 inches, supposing ladder tapping will eventually be employed, there will be only two bark islands formed during the life of the tree; but with clonal seedlings there would be three or more.

SUITABILITY OF LATEX

The variability of seedling families results in their latex presenting an average of properties for manufacturing processess. This might be considered an advantage. But because latex from different clones has specific properties which can be distinguished with some precision, for any given process a clone can be found which is superior to clonal seedlings. There are certain clones – such as PB 86 and RRIM 513 – which give a latex which is highly satisfactory for all manufacturing purposes.

SUSCEPTIBILITY TO DISEASE

The variability of clonal seedlings militates against any stem or leaf disease becoming really severe in any planting. On the other hand some clones show exceptional susceptibility, the clearest example being the severity of pink disease on clones Lun N, RRIM 501 and RRIM 618. The disease does not, however, occur in coastal alluvial regions; moreover it can be controlled. The major pathological problem on rubber is root disease. While clones continue to be budded on seedling stocks there is hardly a possibility of clonal difference appearing. In any event, the root disease fungi are non-selective in their attack.

SITE

The choice of a clone for a given site is important, some in particular doing much better in some situations than in others. Tjir 1, PB 86 and Glen 1, are all much affected in their performance by soil type. There are also other factors involved, and information is constantly being obtained concerning the suitability of clones for various positions. Clonal seedlings, being more variable, are less dependent on local conditions. There are some places, such as eroded hilltops and exposed situations, for which clones are less suitable, particularly those prone to wind damage.

IMPROVEMENT

The periodic reports of large scale trials of RRIM 600 series clones (the latest of which is in this issue) illustrate the steady advance that may be expected in securing new clones of high yield potential and desirable secondary characteristics. Progress is much slower in selecting improved clonal seedling material and producing it on a large scale. The selfed progeny of any clone at present planted on a large scale is unlikely to surpass that of Tjir 1; certainly a performance exceeding that of new clones cannot be foreseen.

Suitably combining clones that are self-sterile, male or female-sterile, to ensure cross pollination, may give better seedling families than those that are obtainable on a commercial scale today. Even so, the establishment of such gardens is a speculation and, when testing of the progeny is completed, the results may not justify large scale use of the material.

Other types of speculative seed garden have been suggested; for instance, those in which the parent clones combine superior breeding strains. Seed gardens can be planted with a large number of good parents to encourage cross pollination, provided that the flowering periods of the clones overlap. The difficulty is to select clones which will flower simultaneously and produce good progeny in the possible combinations, including selfed progeny. Even then there is a further difficulty in that the most vigorous families may not be the highest yielding. Selection from very mixed progenies therefore involves a certain risk that potentially higher yielding trees will be eliminated in favour of, or will be suppressed by, more vigorous ones. The type of seed garden which is most desirable in theory will take many years to achieve in practice. The proof of its progeny will take much longer.

There is another kind of breeding programme, which we have embarked on — inbreeding — with the aim of producing trees which are substantially uniform in their genetic make-up. These, when later crossed, may show hybrid vigour; but this development does not lie in the near future.

GENERAL CONCLUSIONS

Buddings are in general superior to seedlings in the all-important matter of yield. They can be tapped at a higher intensity; their shape gives

more scope for the utilisation of bark, leaving more time for bark renewal. On the score of the rate of girthing, thickness of the virgin bark and the rate of bark renewal, the recommended planting material of either type differs too little for one to be held to have an advantage over the other, provided both are employed at the recommended densities — which also are in the right range for economic tapping. In securing a regular stand, the uniformity of clones weighs in their favour, while the necessity for extra thinning counts against clonal seedlings. It also adds to the cost of planting, largely offsetting the saving of a year compared with clones budded in the field. Even so, somewhat cheaper costs can be obtained with clonal seedlings in the hands of those who do not intend to practice good husbandry. The variability of clonal seedlings is to some extent in their favour from the point of view of spreading disease risks, and also for the resulting average quality of their latex. Finally there is the most important point that the improvement and multiplication of clones proceeds faster than the improvement and production of clonal seedlings. It is unlikely that this trend will be reversed within the foreseeable future.

Spraying Machinery for Estate Use

ALL TOO OFTEN IN THE PAST ESTATES have depended on brushes or on cheap household sprayers for applying fungicides or insecticides in the field. More robust and efficient spraying machinery has come into general use, with the extended employment of weedkillers, but there is still uncertainty as to what are the best models for particular purposes. We have had a variety of commercial sprayers in regular use for several years on our Experiment Station both in experiments and in routine pest and disease work. This article, by describing the principles on which they work, will show that spraying machines can be classified into a few well-defined types, all of which are developments from a simple basic form.

Every sprayer consists of a container for the liquid, a pump, a lance fitted with a nozzle to break the liquid up into a fine spray, and usually with a tap to control the flow. The types differ in their general form according to

Figure 1. Spraying nursery plants with a garden syringe to control scale insects.

Figure 2. A hand sprayer being used to control yellow tea mites on young seedlings.

whether the container, when full of liquid, is light enough to be held in the hand, or whether it is to be supported on the shoulders or rested on the ground. This divides them into hand sprayers of 1 to 4 pints capacity, knapsack sprayers of 1 to 3 gallons, and bucket sprayers of 3 gallons and over. All three types may be made to give a continuous spray whilst being pumped, or to be pumped up immediately after filling so that the operator can then concentrate on directing the spray.

The simplest sprayer of all is the garden syringe, in which the barrel of the pump is both the container and the lance for directing the spray. It is useful on rubber estates for churning up kerosene with soapy water to make an emulsion, and for applying it to nursery plants on a small scale (*Figure 1*).

HAND SPRAYERS

The simplest hand sprayer is a syringe to which a container holding about a pint of fluid has been added to increase its capacity. A common form is the hand sprayer used for applying household insecticides, in which the fluid is sucked out of the container and atomised by a jet of air, as in a scent sprayer. These models are cheap but are not sufficiently robust and are too tiring to use in the field. In the small hand sprayer shown in *Figure 2*, a fine spray is produced by pumping the liquid through an atomising nozzle. A pneumatic hand sprayer (*Figure 3*) has a container that can be placed on a flat surface for filling and pumping, and held in one hand for spraying, with a trigger near the handle. The pump is built in. A short lance 6 inches or 1 foot in length may be fitted before attaching the nozzle. As the pressure drops with the output of spray it

Figure 3. Treating moulay rot with a pneumatic hand sprayer.

can be made up with few strokes of the pump. It is suitable for small scale use in controlling mouldy rot, where the requirement is for a portable sprayer delivering a narrow cone of spray, and where the fungicides used are emulsions or solutions, so that there is nothing to settle out and clog the machine.

Figure 4. Applying a suspension of lead arsenate to destroy leaf-eating weevils, using a sprayer in which the pump is combined with the lance.

KNAPSACK SPRAYERS

The simplest knapsack sprayer is but a self-supplying syringe, pumped by the operator as he directs the spray, drawing fluid from a container on his back (*Figure 4*). It is mechanically simple and cheap, although tiring in use. A more elaborate type has the pump built inside the knapsack container and operated by a lever usually coupled to an agitator, making the sprayer (*Figure 5*) suitable for applying Bordeaux mixture. The operating pressure is low in the simplest models of this type in which the pump is a simple diaphragm; higher pressures, up to 120 lb per square inch, are obtained with a piston pump.

Figure 5. Treating Gloeosporium leaf disease using a sprayer with the pump attached to the container.

The pneumatic principle is of particular value in knapsack sprayers as they can readily be pumped up on the ground and then slung on the shoulders, leaving the operator free to concentrate on directing the spray. Just as with the pneumatic hand sprayers, the pressure will drop as the fluid escapes from the nozzle. However, unlike hand sprayers they are inconvenient to repump at intervals as the whole apparatus would have to be unslung and placed on the ground. Consequently pneumatic knapsacks are made to hold a pressure greater than that required simply to eject a spray of suitable form from the nozzle. A pressure-reducing valve may be fitted to the lance to control

Figure 6. Filling a pneumatic sprayer with built-in pump.

the pressure fed to the nozzle. If the valve is left fully open, fluid is forced through the nozzle at too high a pressure, giving an excessive rate of output and possibly spoiling the characteristic of the spray. A pressure-reducing valve can be dispensed with if the nozzle used gives a satisfactory spray over a wide pressure range, and if the operator sweeps the spray over the target more rapidly at first to allow for the initially larger output.

In the simplest type of pneumatic sprayer the pump is built in, down the centre of the container. For filling, either the pump unscrews or there is a filling port towards one side of the container (*Figure 6*). The working pressure is sufficient for a lance of several feet to be used, if so desired. There will be a limit above which it is difficult or even dangerous to compress the air further. There have been accidents on estates with these machines when the safety device, containing copper foil which blows out when the pressure gets too high, has been blocked with a thick metal disc. When filling a knapsack sprayer, sufficient space must be left for the contained air, compressed to the maximum working pressure, to drive out all the spray fluid without its pressure dropping below the minimum required to deliver an adequate spray. If too much fluid is put into the container the air present, compressed to the pressure for which the sprayer was designed, will be insufficient to empty it. If there is too little fluid, filling time and pumping effort will be wasted. The amount of fluid to be put in will be stated in the manufacturers' instructions.

A simple pneumatic sprayer loses its air pressure when the fluid is all expelled. Recharging it, even when correctly filled, can be very tedious; as the pressure inside rises, less and less air is injected at each stroke. This effect is overcome by an improved design which is operated in

Figure 7. Pumping a charge of liquid into a pneumatic sprayer with removable pump.

the following manner. First, air is pumped into the container to the minimum pressure required to work the nozzle; then the fluid is pumped in, compressing the air still further to the maximum for which the machine is designed, as shown by a gauge. The quantity of fluid is then automatically correct. When it has all been discharged the air pressure is not lost, because a valve floating in the spray fluid shuts off the container when it is empty. A pressure-retaining pneumatic knapsack sprayer with removable (*Figure 7*) or separate pump is unquestionably the best for large scale estate work. Under the battery system, up to twelve sprayers can be fed from one filling station equipped with a single, efficient, heavy pump. The pressure gauge on each container enables it to be filled correctly and tells the operator how much fluid remains. Pressure-retaining sprayers may be left overnight charged with liquid, but they should not be left charged with air only as the ball valve is then forced into its seating.

Figure 8. A self-supplying syringe with double-action pump being used to control Gloeosporium leaf disease.

BUCKET SPRAYERS

Figure 9. A stirrup pump being used with a long lance to treat pink disease.

Bucket sprayers include all types that are too heavy to be carried in the hand or on the shoulders. Only in the simplest models is the container an ordinary bucket; in improved forms a specially designed tank takes its place.

The simplest bucket sprayer is the self-supplying syringe, drawing the spray fluid through a side tube from a bucket. Pump and lance may be combined in such a sprayer (*Figure 8*), which is used by a single operator, usually with a double action pump to give a continuous spray uninterrupted by the pumping strokes. A much more efficient pump can be employed if it can be supported on the ground, one man

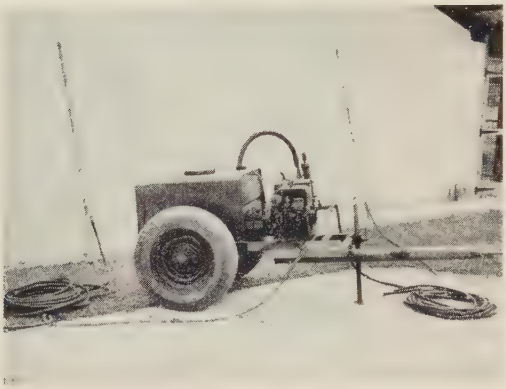


Figure 10. A power-operated sprayer adapted for treating pink disease on the R.R.I. Experiment Station.

concentrating on pumping, another controlling the lance, while a third fills the container. The pump may be placed in the spray fluid, as is the stirrup pump (*Figure 9*), or it may be placed on the ground and withdraw the fluid by a short supply tube. The latter system enables foot or engine power to be used. The standard power-operated sprayer consists of one or more lances fed by a pump from a non-pressurised container in which the spray fluid is kept agitated. The whole unit may be mounted on a wheeled chassis (*Figure 10*). A useful improvement on the bucket sprayer worked by a pump standing on the ground is the addition of a pressurised tank that evens out the flow when the pump is being used continuously, and can also be used to hold 1 to 2 gallons of fluid (*Figure 11*). The latter is in effect a more powerful equivalent of the largest size pneumatic knapsack sprayer, which it has largely replaced. It is sometimes for convenience mounted on a chassis carrying also 10 to 20 gallons of spray fluid in a non-pressurised container. There are models (necessarily chassis mounted and with engine-driven pump) in which the whole container is pressurised as a reservoir giving a smooth output at the higher pressure. The result is a versatile machine that can be used as a source of compressed air for such purposes as inflating tyres and spray painting, as well as for dusting and spraying crops. *Figure 12* shows a machine of this type in use in a nursery, with two lances fed from the pressurised tank. If a heavy machine of this type is to be used, the nursery must be laid out on flat land, with paths to allow passage of the sprayer.

Figure 11. A pneumatic sprayer, pumped to give continuous operation.

No details are given here of the design of lances and nozzles, nor have mist blowers and fogging machines been mentioned. These subjects, and dusting machines, will be dealt with in future articles.

Figure 12. Experimental spraying in a nursery to control bird's eye spot.

Clones RRIM 600 to 618

THIS IS AN INTERIM REPORT, on the second year of tapping of the large scale trial at our Experiment Station where clones RRIM 600 to 618 are being compared with RRIM 501 and Tjir 1. There are five plots of each clone; each plot is one third of an acre; the trial design is a balanced incomplete block. The results of the first twelve months of tapping – October 1955 to September 1956 – were reported in *Planters' Bulletin 30*. Through the second twelve months the stand has remained at 140 trees per acre; however, thinning was undertaken immediately after the close of this second year of tapping.

The results are tabulated. The first table sets out the yields for the second year and for the first two years together, with relevant information, expressed as means for the five plots. The second table deals in the same way with girths and bark thicknesses. It is seen that the leading clones in terms of yield per tree and yield per acre are in approximately the same order in the second year as in the first year. Their ranking based on cumulative yield over the two years of tapping is: RRIM 613, 614, 605, 610, 603, 600, 616, 607 and 606. All these clones have yielded more than the mean of the whole trial and more than RRIM 501. Two of the nine – RRIM 613 and 616 – have proved very liable to suffer from wind breakage and loss. This has been noticeable in trials on more exposed sites than our Experiment Station. RRIM 603 is top heavy and many trees need to be roped up during the early years of immaturity. However, if this attention is given, no further trouble is experienced after the trees have reached tappable size. Even so, this characteristic and the treatment required to correct it argue against employing RRIM 603 in exposed situations. RRIM 606 and 614 have suffered limited losses due to wind damage in some trials, but not to an extent to constitute a defect of these two clones.

LARGE SCALE TRIAL OF CLONES RRIM 600–618 AT THE R.R.I. EXPERIMENT STATION

Initial planting distance 20 ft × 10 ft. Stand throughout the period reviewed 140 trees/acre.

Yield

Clone	*Parentage*	*Mean yield in second year of tapping*				*Mean yield over two years of tapping*				*Trees in tapping in July 1957*		
		Grams per tree per tapping	*Rank*	*Pounds per acre per annum*	*Rank*	*Grams per tree per tapping*	*Rank*	*Cumulative lb per acre over 2 years*	*Rank*	*Total number*	*Percentage of stand*	*Brown bast cases*
RRIM 600	Tjir 1 × PB 86	29.1	7	1170	4	26.7	7	1703	6	222	95	1
RRIM 601	Tjir 1 × Gl 1	22.4	16	884	12	19.5	17	1353	11	227	96	–
RRIM 602	Tjir 1 × Gl 1	21.4	17	858	14	16.0	19	1139	15	230	98	–
RRIM 603	PB 86 × Pil B84	27.4	8	1060	7	25.9	8	1714	5	213	93	3
RRIM 604	Tjir 1 × PB 49	23.4	15	810	15	23.3	12	1260	14	207	88	–
RRIM 605	Tjir 1 × PB 49	31.3	3	1285	3	30.2	3	2033	3	225	96	1
RRIM 606	Tjir 1 × PB 49	25.0	10	1024	8	22.9	13	1563	9	228	98	–
RRIM 607	Tjir 1 × PB 49	24.1	12	990	10	23.5	11	1599	8	216	92	1
RRIM 608	AVROS 33 × Tjir 1	20.0	19	638	20	19.0	18	901	20	162	69	–
RRIM 609	AVROS 157 × BD 5	24.5	11	805	16	24.0	10	1073	17	205	89	1
RRIM 610	RRIM 504 × Tjir 1	30.2	5	1139	5	29.5	4	1716	4	212	91	–
RRIM 611	RRIM 504 × Tjir 1	23.5	14	897	11	21.9	15	1274	13	220	94	–
RRIM 612	AVROS 157 × PB 49	14.5	21	614	21	13.6	21	986	18	232	99	–
RRIM 613	Tjir 1 × RRIM 509	38.1	2	1551	1	34.0	2	2495	1	220	96	2
RRIM 614	Tjir 1 × RRIM 509	39.3	1	1510	2	39.3	1	2414	2	220	94	–
RRIM 615	RRIM 511 × Tjir 1	17.7	20	639	19	13.8	20	813	21	196	84	–
RRIM 616	Tjir 1 × RRIM 507	29.6	6	1017	9	26.9	6	1601	7	212	93	1
RRIM 617	BR 2 × RRIM 500	26.8	9	880	13	24.1	9	1083	16	187	81	–
RRIM 618	Lun N × RRIM 501	24.0	13	711	18	22.0	14	974	19	170	71	–
RRIM 501	Pil A44 × Lun N	31.0	4	1081	6	27.5	5	1440	10	206	89	–
Tjir 1		20.9	18	792	17	20.3	16	1299	12	216	92	2
Mean		25.9		969		24.0		1449			90	

LARGE SCALE TRIAL OF CLONES RRIM 600 – 618 AT THE R.R.I. EXPERIMENT STATION

Initial planting distance 20 ft × 10 ft. Stand throughout the period reviewed 140 trees/acre.

Girth and bark thickness

Clone	Mean girth in inches at 60 inches from the union				Bark thicknesses in mm in October 1957						Stand in July 1957	
							Renewed bark					
	In October 1957	Rank	Increment Nov 56 – – Oct 57	Rank	Virgin bark	Rank	1st year	Rank	2nd year	Rank	Total trees	Wind damaged during year
RRIM 600	23.0	10	1.6	3	7.3	14	6.2	5	6.6	5	234	–
RRIM 601	24.0	2	1.2	11	7.9	5	6.0	9	6.4	7	236	–
RRIM 602	23.9	3	1.5	5	8.7	1	6.8	1	7.1	1	235	1
RRIM 603	23.6	6	1.6	3	7.6	9	6.4	4	6.7	4	228	1
RRIM 604	23.1	8	1.3	7	7.7	8	5.9	12	6.3	9	235	–
RRIM 605	22.8	11	1.3	7	7.5	12	6.1	7	6.3	9	235	–
RRIM 606	23.8	4	1.1	15	8.0	3	6.8	1	7.0	2	233	–
RRIM 607	23.8	4	1.4	6	7.1	18	6.0	9	6.4	7	235	–
RRIM 608	21.3	20	0.7	20	7.6	9	5.7	14	6.2	12	235	–
RRIM 609	22.4	14	1.9	1	8.0	3	6.2	5	6.8	3	231	–
RRIM 610	22.2	16	1.1	15	7.2	15	5.7	14	5.8	15	233	–
RRIM 611	22.3	15	1.2	11	6.6	21	5.3	20	5.2	20	233	–
RRIM 612	25.0	1	1.8	2	7.8	7	6.0	9	6.3	9	234	–
RRIM 613	23.1	8	0.7	20	7.4	13	5.4	19	5.5	18	228	3
RRIM 614	22.7	12	1.3	7	8.3	2	6.6	3	6.5	6	233	2
RRIM 615	21.8	18	0.9	19	7.2	15	5.5	17	5.7	16	233	1
RRIM 616	22.6	13	1.2	11	6.8	20	5.6	16	5.5	18	228	1
RRIM 617	21.8	17	1.3	7	7.9	5	5.8	13	5.9	14	232	–
RRIM 618	20.9	21	1.0	17	7.6	9	5.5	17	5.6	17	238	–
RRIM 501	21.6	19	1.0	17	6.9	19	5.2	21	5.1	21	232	–
Tjir 1	23.5	7	1.2	11	7.2	15	6.1	7	6.0	13	234	–
Mean	22.8		1.2		7.5		5.9		6.1			

Of the higher yielding clones, RRIM 600, 603, 605, 607 and 614 are among the most vigorous in tapping, showing the best growth and bark renewal. Although there have been a few cases of brown bast, especially in the higher yielding clones, the incidence is favourably low at present.

During the year latex was collected from each clone individually to prepare specimens of ribbed smoked sheet, pale crepe and latex concentrate. All clones in the trial gave satisfactory RSS, although the sheets prepared from RRIM 501 and 617 were softer than the rest. It may also be noted here that the d.r.c of field latex of clones RRIM 609 and 617 was considerably below average.

Sodium bisulphite only was added to the field latex before coagulation and preparation of pale crepe specimens. The crepes have been classified according to their hardness (hard, medium and soft) and colour. the explanation of the colour classification being as follows:

White – suitable for crepe production.

Pale yellow – suitable for crepe production provided that fractionation or bleaching is employed.

Light yellow – probably suitable for pale crepe production but a larger yellow fraction must be separated off or more bleaching is necessary.

Yellow and deep yellow – unsuitable for pale crepe production.

Our experience has been that the colour of crepe from trees of the same clone varies considerably with the site on which the trees are growing, as well as with the tapping system and day-to-day climatic conditions. The nature of this variation cannot always be predicted; in particular, those clones whose crepe has been classified as pale yellow or light yellow at Sungei Buloh may, on different soils, give a pale crepe with more or less intense colouration. Hence the classification of suitability applies strictly only to the present trial site. However, the clones shown as giving white crepes will probably yield latex of suitable colour for pale crepe manufacture on all sites. The asterisks indicating the degree of suitability for pale crepe production take into account not only colour but also hardness, which also shows considerable variation between different sites. As both features generally improve as the trees grow older, the present judgement is the least favourable that can be expected on that particular site.

The latex samples for the preparation of latex concentrate were ammoniated in the field. Our judgement of the suitability of latex for concentration is based on the mechanical stability of the latex after storage for one month and three months. The interpretation of the classification is as follows:

Suitable (**) – latices expected to give satisfactory, stable concentrate under normal conditions on all sites.

Marginal (*) – intermediate latices which may give difficulties on

particular sites if they form the sole source of latex, but which would prove suitable when mixed with latex from preferred clones or seedlings.

Unsuitable (–) – latices which are expected to give unsuitable concentrate on all sites if the concentrate is prepared by conventional methods using ammonia alone for preservation. Only very limited addition of latex in this class to other field latex could be permitted.

We have presented this information so that producers may judge for themselves which of these clones is most likely to prove satisfactory for their purposes. As we have pointed out before, some clones may prove to be precocious and others to be slow starters in yield, therefore we believe that extended trials lasting several years must be completed before new clones can be recommended for planting on a large scale. A few small trials on estates have come into tapping during the last year and the yield records sent to us are in good agreement with those reported here. We are most appreciative of the generous cooperation which we have received from managers and planting companies in the conduct of these trials which, in a few years, should give us most of the information we need.

CHARACTERISTICS OF THE PRODUCT FROM THE VARIOUS CLONES

Clone	*Pale crepe*			*Suitability of latex for concentration*
	Colour	*Hardness*	*Suitability*	
RRIM 600	white	hard	* * *	–
RRIM 601	yellow	medium	–	*
RRIM 602	pale yellow	hard	*	* *
RRIM 603	white	soft	* *	–
RRIM 604	deep yellow	hard	–	*
RRIM 605	yellow	medium	–	–
RRIM 606	pale yellow	medium	*	* *
RRIM 607	yellow	hard	–	* *
RRIM 608	yellow	medium	–	–
RRIM 609	pale yellow	hard	*	* *
RRIM 610	deep yellow	medium	–	–
RRIM 611	pale yellow	medium	*	*
RRIM 612	white	medium	* *	* *
RRIM 613	white	soft	* *	–
RRIM 614	white	medium	* *	* *
RRIM 615	pale yellow	hard	*	*
RRIM 616	white	hard	* * *	–
RRIM 617	pale yellow	soft	*	* *
RRIM 618	white	hard	* * *	–
RRIM 501	light yellow	soft	*	* *
Tjir 1	light yellow	hard	* *	*

Journal

The *Journal of the Rubber Research Institute of Malaya* Volume 15 Part 3 contains a paper by Dr E.W. Bolle-Jones reporting a preliminary investigation of the diagnosis of the mineral status of mature rubber trees by leaf and bark analysis. The investigation deals with the relationship between the mineral composition of leaves and bark. The conclusion reached is that bark analysis offers a means almost as satisfactory as leaf analysis for detecting responses to fertilisers containing phosphorus and potassium. The same issue also contains three further papers by Dr Bolle-Jones. Dealing with the effects of cobalt, molybdenum and zinc on the growth of seedlings in sand culture, they complete the record of his work on the mineral nutrition of hevea.

In collaboration with Mr V.R. Mallikarjuneswara, Dr Bolle-Jones has shown, by using elaborate purification techniques, that minute amounts of cobalt have a beneficial effect on the growth of seedlings grown in sand. It is not established that cobalt is an indispensable nutrient element, nor is it expected that deficiency of cobalt is a limiting factor in Malayan soils.

Dr Bolle-Jones has demonstrated symptoms of molybdenum deficiency, but finds that the effects vary according to the levels of other applied nutrients. He suggests that the deficiency may occur in Malaya, unaccompanied by well defined foliar symptoms.

Dr Bolle-Jones has found that the symptoms of zinc deficiency are readily produced in seedlings grown in sand, and that lack of this element markedly reduces their growth. He does not think it likely that zinc deficiency could be a prevalent cause of malnutrition in hevea grown in the generally acid soils of Malaya, nor have symptoms associated with zinc deficiency yet been observed in the field.

A paper by Dr G.A. Watson describes an experiment in which *Centrosema pubescens* and the non-leguminous creeper *Mikania scandens* were grown in pot culture in the presence and absence of nitrogenous fertilisers. In the absence of such fertilisers *Mikania scandens* almost died out, while the *Centrosema pubescens* grew vigorously and appeared to fix the equivalent of some nine hundredweights per acre of ammonium sulphate in a period of five months from sowing.

A New Approach to Yield Stimulation

In our September issue we referred to papers which Mr D.H. Taysum, of our Chemical Division, has had accepted for publication in foreign scientific journals.

A later communication is a short paper by Mr Taysum, published in *Nature*, announcing results which he interprets as indicating an immunity reaction by hevea to bacteria in its latex vessels. Working on the lines that bacteria are responsible for blocking the latex vessels, and hence limiting the crop obtained from the tree, Mr Taysum has produced an antibiotic dressing which has patent protection as a yield stimulant. The mixture has given some impressive increases in the yield of individual seedling trees, and it has the further highly interesting feature that it appears to work best where 'conventional' yield stimulants are least effective. The in-

vestigation has reached the stage when a few small scale trials are being put down on cooperating estates. The mixture is not yet available for commercial testing.

Dusting Planting Material for Export

When planting material is sent from one country to another there is a danger that a pest or disease might be carried with it. It was to protect the agricultural industries in this part of the world that a Plant Protection Agreement for the South East Asia and Pacific Region was reached, in 1955. To this Agreement the Government of the Federation of Malaya adheres. The Plant Protection Committee formed under the Agreement and charged with the task of advising governments on phytosanitary measures, at its meeting held last December, recommended that all budwood and other propagating material of hevea rubber moving from one territory to another within the region should be dusted with sulphur before shipment. The treatment is designed to minimise the danger of distributing rubber diseases, especially strains of *Oidium heveae;* it is necessary because fungal spores are virtually impossible to detect by visual inspection hence propagating material can be regarded as free from infection only if it has been treated in some way.

In future, those exporting rubber planting material will normally be required to dust it with sulphur before despatch, in order to obtain the necessary certificate of freedom from pests and diseases issued by the Director of Agriculture. Sulphur dust is easy and safe to apply, and the amount to be used is not critical. Seeds and sulphur should be thoroughly mixed to dust the seed coat evenly; similarly, budwood should be lightly dusted to coat it evenly.

It should be noted that some territories have laid down special requirements for the treatment of propagating material being imported by them. An exporter who is in doubt as to the correct procedure to follow should seek the advice of his State Agricultural Officer, or of the Director of Agriculture in Kuala Lumpur.

We have pleasure in inserting this note at the request of the Director of Agriculture, Federation of Malaya.

Dowpon

The use of Dowpon as an eradicant for grasses, including lalang, was advocated in *Planters' Bulletin 23* and *29* on the basis of successful trials carried out by the R.R.I. Subsequent trial by planters has not always resulted in a satisfactory kill, and some disappointment regarding the effectiveness of Dowpon has been expressed. We would like to stress that Dowpon does not kill in exactly the same way as does sodium arsenite, but exerts its main toxic effect on the roots or rhizomes rather than by a direct kill of the leaf on contact. Dowpon can be translocated from the leaves to the roots but, to obtain the maximum effect, the volume of spray should be large enough to produce liquid run-off that will reach and directly affect the crown and surface roots of the plant. Such run-off can be obtained by spraying at the rate of 100 gallons per acre. To economise on application costs, planters may have used

less than this volume of water, with consequent disappointing results. Our normal recommendation for the elimination of grasses by Dowpon is to apply the chemical at the rate of 10 lb per 100 gallons per acre; when spraying planting rows, not less than 1 gallon of the solution should be applied to every chain length of the strip. For the elimination of lalang a stronger solution, of 15 lb per 100 gallons, should be used. These applications of Dowpon can be expected to give good results, although it may take up to six weeks for the full effect to become apparent.

Improved Tree and Stump Poison

Normal butyl 2,4,5-T is becoming established as an alternative poison to sodium arsenite for both trees and stumps. Recently, in small scale tests, we have obtained much better results with 2,4,5-T by adding a small quantity of boric acid. The roots of trees and stumps poisoned with the mixture decayed much sooner than those poisoned with 2,4,5-T alone, or with sodium arsenite. The importance of hastening the decay of the old root systems has been emphasised in the article 'Root Disease and Replanting' in *Planters' Bulletin 35*.

The compound of boron which we used was boric acid, also called boracic acid, which is easily obtainable. It was added to the recommended concentration of 5% 2,4,5-T in diesel oil at the rate of 0.05%. The most suitable grade to obtain is the BP extra fine powder. If boric acid crystals are obtained, they should be ground to a fine powder before use. The powder will disperse best if it is first stirred into a little of the oil, before mixing with the main bulk. The solubility of boric acid in diesel oil is so low that not even 0.05% will not completely dissolve. The mixture should therefore be stirred frequently during application.

The striking results and trifling cost of the method make it worth trying where 2,4,5-T is being used as a tree or stump poisoning. One ounce of boric acid, costing 4 cents, is sufficient for 12 gallons of solution.

Water Pollution

Factory effluents are usually disposed of by discharging them into a convenient stream, the resulting pollution sometimes advertising itself by a most unpleasant smell which pervades the area of the factory and for two or three miles downstream. The trouble is caused by the increased content of oxidisable organic matter which, by biochemical action, depletes the dissolved oxygen in the stream and creates conditions under which the usual plant and animal life cannot continue.

The R.R.I. has started work directed at overcoming the pollution problem caused by latex factories. All producers of latex concentrate have been circularised to obtain basic information, such as production levels and water usage. From a recent case of pollution it is evident that increasing attention will have to be given to effluent disposal from factories near inhabited places. Those confronted with the problem are invited to contact us for assistance in dealing with it. There has been no problem yet with factories that do not produce concentrate.

Journal of the Rubber Research Institute of Malaya

Our *Journal* is available free of charge to all Managers of estates over 100 acres in Malaya, North Borneo and Nigeria. Hitherto it has automatically been sent to all on our free mailing list, but with Part 3 we are discontinuing the practice. Part 4 and subsequent issues will be distributed free of charge only to those who indicate their desire to receive it, by completing and returning to us the business reply card enclosed with the free list copies of Part 3.

Telephone Number

The telephone number of the R.R.I. has been changed to:

Kuala Lumpur 72051

OUR COVER SHOWS EXPERIMENTAL SPRAYING WITH DOWPON TO KILL LALANG.

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